Federal Communications Commission
Washington, D. C. 20554

Approved by OMB
3060-0627
Expires 01/31/98

FOR FCC USE ONLY

FCC 302-AM
APPLICATION FOR AM BROADCAST STATION LICENSE

(Please read instructions before filling out form.

FOR COMMISSION USE ONLY
FILE NO. BAML-20100722HYX

SECTION I - APPLICANT FEE INFORMATION

1. PAYOR NAME (Last, First, Middle Initial)

Saga Broadcasting, LLC

MAILING ADDRESS (Line 1) (Maximum 35 characters)
73 Kercheval Avenue

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
Grosse Pointe Farms	MI	48236

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
313-886-7070	KPUG	58887

2. A. Is a fee submitted with this application? [✓] Yes [ ] No

B. If No, indicate reason for fee exemption (see 47 C.F.R. Section

[ ] Governmental Entity [ ] Noncommercial educational licensee [ ] Other (Please explain):

C. If Yes, provide the following information:

Enter in Column (A) the correct Fee Type Code for the service you are applying for. Fee Type Codes may be found in the "Mass Media Services Fee Filing Guide." Column (B) lists the Fee Multiple applicable for this application. Enter fee amount due in Column (C).

(A) FEE TYPE CODE	(B) FEE MULTIPLE	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
MMR	0001	$615.00	

To be used only when you are requesting concurrent actions which result in a requirement to list more than one Fee Type Code.

(A)	(B)	(C)	FOR FCC USE ONLY
MOR	0001	$705.00	

	TOTAL AMOUNT REMITTED WITH THIS APPLICATION	FOR FCC USE ONLY
ADD ALL AMOUNTS SHOWN IN COLUMN C, AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE.	$1,320.00	

SECTION II - APPLICANT INFORMATION		
1. NAME OF APPLICANT Saga Broadcasting, LLC		
MAILING ADDRESS 73 Kercheval Avenue		
CITY Grosse Pointe Farms	STATE MI	ZIP CODE 48236

2. This application is for:

☑ Commercial ☐ Noncommercial

☑ AM Directional ☐ AM Non-Directional

Call letters	Community of License	Construction Permit File No.	Modification of Construction Permit File No(s).	Expiration Date of Last Construction Permit
KPUG	Bellingham, WA	NA	NA	NA

3. Is the station now operating pursuant to automatic program test authority in accordance with 47 C.F.R. Section 73.1620?

☐ Yes ☐ No

If No, explain in an Exhibit.

Exhibit No. N/A

4. Have all the terms, conditions, and obligations set forth in the above described construction permit been fully met?

☐ Yes ☐ No

If No, state exceptions in an Exhibit.

Exhibit No. N/A

5. Apart from the changes already reported, has any cause or circumstance arisen since the grant of the underlying construction permit which would result in any statement or representation contained in the construction permit application to be now incorrect?

☐ Yes ☐ No

If Yes, explain in an Exhibit.

Exhibit No. N/A

6. Has the permittee filed its Ownership Report (FCC Form 323) or ownership certification in accordance with 47 C.F.R. Section 73.3615(b)?

☐ Yes ☐ No

☑ Does not apply

If No, explain in an Exhibit.

Exhibit No.

7. Has an adverse finding been made or an adverse final action been taken by any court or administrative body with respect to the applicant or parties to the application in a civil or criminal proceeding, brought under the provisions of any law relating to the following: any felony; mass media related antitrust or unfair competition; fraudulent statements to another governmental unit; or discrimination?

☐ Yes ☑ No

If the answer is Yes, attach as an Exhibit a full disclosure of the persons and matters involved, including an identification of the court or administrative body and the proceeding (by dates and file numbers), and the disposition of the litigation. Where the requisite information has been earlier disclosed in connection with another application or as required by 47 U.S.C. Section 1.65(c), the applicant need only provide: (i) an identification of that previous submission by reference to the file number in the case of an application, the call letters of the station regarding which the application or Section 1.65 information was filed, and the date of filing; and (ii) the disposition of the previously reported matter.

Exhibit No.

8. Does the applicant, or any party to the application, have a petition on file to migrate to the expanded band (1605-1705 kHz) or a permit or license either in the existing band or expanded band that is held in combination (pursuant to the 5 year holding period allowed) with the AM facility proposed to be modified herein?

☐ Yes ☑ No

If Yes, provide particulars as an Exhibit.

Exhibit No.

The APPLICANT hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because use of the same, whether by license or otherwise, and requests and authorization in accordance with this application. (See Section 304 of the Communications Act of 1934, as amended).

The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

CERTIFICATION

1. By checking Yes, the applicant certifies, that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862, or, in the case of a non-individual applicant (e.g., corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits that includes FCC benefits pursuant to that section. For the definition of a "party" for these purposes, see 47 C.F.R. Section 1.2002(b).

☑ Yes ☐ No

2. I certify that the statements in this application are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

Name	Signature	
Michael Williams		
Title	Date	Telephone Number
Vice President	7/22/2010	(360) 734-9790

WILLFUL FALSE STATEMENTS ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION

FCC NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT AND THE PAPERWORK REDUCTION ACT

The solicitation of personal information requested in this application is authorized by the Communications Act of 1934, as amended. The Commission will use the information provided in this form to determine whether grant of the application is in the public interest. In reaching that determination, or for law enforcement purposes, it may become necessary to refer personal information contained in this form to another government agency. In addition, all information provided in this form will be available for public inspection. If information requested on the form is not provided, the application may be returned without action having been taken upon it or its processing may be delayed while a request is made to provide the missing information. Your response is required to obtain the requested authorization.

Public reporting burden for this collection of information is estimated to average 639 hours and 53 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, can be sent to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0627), Washington, D. C. 20554. Do NOT send completed forms to this address.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 6 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507.

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant

Saga Broadcasting , LLC

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

[X] Station License [ ] Direct Measurement of Power (Method of Moments)

1. Facilities authorized in construction permit

Call Sign	File No. of Construction Permit (if applicable)	Frequency (kHz)	Hours of Operation	Power in kilowatts	
				Night	Day
KPUG		1170	ULN	5.0	10.0

2. Station location

State	City or Town
WA	Bellingham

3. Transmitter location

State	County	City or Town	Street address (or other identification)
WA	Whatcom	Bellingham	2340 E. Sunset Drive

4. Main studio location

State	County	City or Town	Street address (or other identification)
WA	Whatcom	Bellingham	2219 Yew Street Road

5. Remote control point location (specify only if authorized directional antenna)

State	County	City or Town	Street address (or other identification)
WA	Whatcom	Bellingham	2219 Yew Street Road

6. Has type-approved stereo generating equipment been installed? [ ] Yes [X] No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68? [X] Yes [ ] No [ ] Not Applicable

Attach as an Exhibit a detailed description of the sampling system as installed. Exhibit No. Eng Rpt

8. Operating constants:

RF common point or antenna current (in amperes) without modulation for night system	RF common point or antenna current (in amperes) without modulation for day system
10.4	14.9

Measured antenna or common point resistance (in ohms) at operating frequency		Measured antenna or common point reactance (in ohms) at operating frequency	
Night	Day	Night	Day
50	45.3	0	121.1

Antenna indications for directional operation

Towers	Antenna monitor Phase reading(s) in degrees		Antenna monitor sample current ratio(s)		Antenna base currents	
	Night	Day	Night	Day	Night	Day
1 (W) (1032002)	-95.4		0.355			
2 (C) (1032003)	0		1.000			
3 (E) (1032004)	+97.7		0.521			

Manufacturer and type of antenna monitor: Gorman-Redlich CMR

SECTION III - Page 2

9. Description of antenna system ((f directional antenna is used, the information requested below should be given for each element of the array. Use separate sheets if necessary.)

Type Radiator	Overall height in meters of radiator above base insulator, or above base, if grounded.	Overall height in meters above ground (without obstruction lighting)	Overall height in meters above ground (include obstruction lighting)	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.
(3) Uniform cross-section guyed steel tower	65.55	67.0	68.1	Exhibit No.

Excitation [X] Series [ ] Shunt

Geographic coordinates to nearest second. For directional antenna give coordinates of center of array. For single vertical radiator give tower location.

North Latitude				West Longitude			
48 °	46 '	33 "		122 °	26 '	23 "	

If not fully described above, attach as an Exhibit further details and dimensions including any other antenna mounted on tower and associated isolation circuits. Exhibit No. None

Also, if necessary for a complete description, attach as an Exhibit a sketch of the details and dimensions of ground system. Exhibit No.

No change in data on file - BZ-19931115AE

10. In what respect, if any, does the apparatus constructed differ from that described in the application for construction permit or in the permit?

DNA

11. Give reasons for the change in antenna or common point resistance.

Removal of sample loops & isolation coils.

I certify that I represent the applicant in the capacity indicated below and that I have examined the foregoing statement of technical information and that it is true to the best of my knowledge and belief.

Name (Please Print or Type)	Signature (check appropriate box below)
Thomas S. Gorton P.E.	
Address (include ZIP Code)	Date
Hatfield & Dawson Consulting Engineers 9500 Greenwood Ave N Seattle, WA 98103	July 19, 2010
	Telephone No. (Include Area Code) 206-783-9151

[ ] Technical Director

[X] Registered Professional Engineer

[ ] Chief Operator

[ ] Technical Consultant

[ ] Other (specify)

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PAUL W. LEONARD, PE
CONSULTANTS

MAURY L. HATFIELD, PE
(1942-2009)

Engineering Report:

APPLICATION FOR STATION LICENSE

Proof of Performance

KPUG, 1170 kHz

10 kW Daytime 5 kW Nighttime DA-N

Facility ID 58887

Bellingham, Washington

SAGA Broadcasting, LLC, Inc

July 2010

Table of Contents

Purpose of Application

This Engineering Report is part of an application for Direct Measurement of Power by SAGA Broadcasting, LLC, licensee of KPUG-AM, Bellingham, WA.

Background

This station is in a valley surrounded by extremely rugged mountainous terrain in the direction of the pattern minima. Valid measurement of field strength has been a difficult task. Substantial development has taken place over the past 35 years and made duplicating the original measurements troublesome. This station has operated under several STAs due to monitor points being above specified limits. It was therefore decided that a Method of Moments Computer Model proof, as authorized by §73.151(c) of the Commission's rules was a more suitable option for the re-licensing of KPUG than a traditional partial proof of performance.

KPUG operates with a non-directional antenna daytime at a power of 10 kW and a three tower directional antenna for nighttime operation at a power of 5 kW.

Information is provided herein demonstrating that the directional antenna parameters for the licensed pattern have been determined in accordance with the requirements of section §73.151(c) of the Commissions Rules. The system has been adjusted to produce antenna monitor parameters within ± 5 % of ratio and ± 3° of phase of the modeled values, as required by the Rules.

All antenna and sample system measurements used in this report were taken undersigned the morning of February 9, 2010. The existing sample lines were found to be unacceptable, and were replaced during the week of July 12, 2010. The new sample lines were measured on July 15 2010.

Stephen S. Lockwood, P.E.

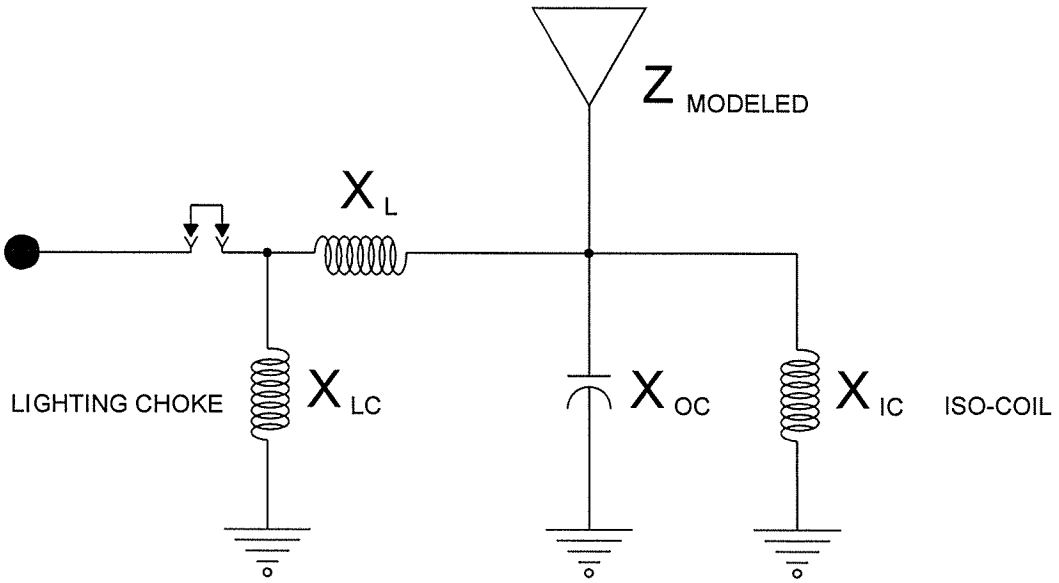
16 July 2010

ITEM 1 - Tower Impedance Measurements and Model Verification

Tower base Impedance measurements were made at the reference point at the output of the Antenna Tuning Units (ATUs). These measurements were made using an HP 8751A network analyzer, an ENI 403LA amplifier and custom manufactured directional couplers in a calibrated measurement system. The other towers within the array were in the open circuit condition (floated).

Standard electrical circuit calculations were used to relate the measured impedance ($Z_{ATU\ Measured}$) to the moment method base modeled impedance ($Z_{Modeled}$). X_L and X_C were calculated for the assumed stray base capacitance and lead inductance for each tower. The measured reactance for the sample loop iso-coil and the lighting choke are included in this model.

The modeled ($Z_{ATU\ Modeled}$) and measured ($Z_{ATU\ Measured}$) base impedance at each ATU output J-plug with the other towers open circuited at their ATU output J-plugs agree within ± 2 ohm and ± 4 % for resistance and reactance.



TOWER	X_{LC} (Ω)	X_L (Ω)	X_{OC} (Ω)	X_{IC} (Ω)	$Z_{MODELED}$ (Ω)	$Z_{ATU\ MODELED}$ (Ω)	$Z_{ATU\ MEASURED}$ (Ω)
TWR #1	+j2600	+j34.2	-j880	+j845	54.7 +j66.6	50.4 +j98	50.4 +j98
TWR #2	+j2600	+j64.0	-j1475	+j845	52.9 +j62.8	45.2 +j121.1	45.3 +j121.1
TWR #3	+j2600	+j38.8	-j1150	+845	54.7 +j66.6	48.5 +j101.8	48.5 +j101.8

Bob Allen, H&D | 3/23/2010 10:28 AM | KPUG CIRCUIT MOM TABLE.dwg | PDF FILE: KPUG MOM TABLE.pdf

HATFIELD & DAWSON
CONSULTING ENGINEERS

ANALYSIS OF TOWER IMPEDANCE MEASUREMENTS TO VERIFY METHOD OF MOMENTS MODEL

RADIO STATION KPUG 03/2010

ITEM 2 - Derivation of Operating Parameters for Directional Antenna

The KPUG antenna previously used sample loops. These loops have been removed and replaced with Delta TCT-2 Toroidal Current Transformers. The isolation coils and sample loops have been removed[1]. The matrix measurements were taken prior to the removal of the sample loops and isolation coils. The spice model has accounted for the removal of this component.

PSpice is an analog circuit simulator computer program. It calculates the voltages and currents of a circuit under a variety in different excitation circumstances, such as DC, AC, and in time using nodal and mesh analysis applications of Kirchhoff's laws (among other features). PSpice was used to model the circuit conditions around the tower bases to derive the antenna monitor parameters based on the tower base currents (magnitude and angle) calculated by the moment method model. The 1987 MicroSim release of this program was used.

Currents From MiniNEC

```
C:\AM\KPUG\Model\KPUG     06-29-2010    09:53:45

CURRENT rms
Frequency   = 1170 KHz
Input power = 5,000. watts
Efficiency  = 100. %
coordinates in degrees
```

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	3.57495	266.8	-.199697	-3.56937
2	0	0	4.66667	3.9382	264.8	-.354808	-3.92218
3	0	0	9.33333	4.14621	263.8	-.450792	-4.12163
4	0	0	14.	4.29208	262.9	-.527105	-4.25959
5	0	0	18.6667	4.38683	262.3	-.588426	-4.34718
6	0	0	23.3333	4.43518	261.7	-.636716	-4.38924
7	0	0	28.	4.43965	261.3	-.67293	-4.38836
8	0	0	32.6667	4.40188	260.9	-.697636	-4.34625
9	0	0	37.3333	4.32321	260.5	-.711223	-4.2643
10	0	0	42.	4.20484	260.2	-.71403	-4.14377
11	0	0	46.6667	4.048	260.	-.706359	-3.98589
12	0	0	51.3333	3.85396	259.7	-.688538	-3.79195
13	0	0	56.	3.62405	259.5	-.660909	-3.56328
14	0	0	60.6667	3.35965	259.3	-.623839	-3.30122
15	0	0	65.3333	3.06217	259.1	-.577713	-3.00718
16	0	0	70.	2.73293	259.	-.522914	-2.68243
17	0	0	74.6667	2.37308	258.8	-.459796	-2.32811

[1]While the three KPUG towers are of identical height and face width, they are not identical towers, the center tower having been installed many years after the two end towers. Because of the different cross-member construction of the center tower, the Commission's rules do not allow the use of a method of moments proof of performance using sample loops.

18	0	0	79.3333	1.98334	258.7	-.388628	-1.94489
19	0	0	84.	1.56345	258.6	-.309482	-1.53251
20	0	0	88.6667	1.11083	258.5	-.221938	-1.08843
21	0	0	93.3333	.616744	258.4	-.124297	-.604089
END	0	0	98.	0	0	0	0
GND	-23.1411	-63.5796	0	8.63358	5.	8.60019	.758571
23	-23.1411	-63.5796	4.66667	8.92273	3.6	8.9051	.560702
24	-23.1411	-63.5796	9.33333	9.05306	2.7	9.04277	.431483
25	-23.1411	-63.5796	14.	9.10226	2.	9.09658	.321346
26	-23.1411	-63.5796	18.6667	9.07977	1.4	9.077	.22448
27	-23.1411	-63.5796	23.3333	8.98996	.9	8.98889	.138528
28	-23.1411	-63.5796	28.	8.83553	.4	8.83531	.0624251
29	-23.1411	-63.5796	32.6667	8.61851	360.	8.61851	-4.36E-03
30	-23.1411	-63.5796	37.3333	8.34099	359.6	8.34076	-.0620857
31	-23.1411	-63.5796	42.	8.00501	359.2	8.00424	-.11091
32	-23.1411	-63.5796	46.6667	7.6128	358.9	7.6113	-.150907
33	-23.1411	-63.5796	51.3333	7.16658	358.5	7.16427	-.182127
34	-23.1411	-63.5796	56.	6.66888	358.2	6.66574	-.204609
35	-23.1411	-63.5796	60.6667	6.12224	358.	6.11835	-.218389
36	-23.1411	-63.5796	65.3333	5.52921	357.7	5.52469	-.223508
37	-23.1411	-63.5796	70.	4.89223	357.4	4.88728	-.219999
38	-23.1411	-63.5796	74.6667	4.21339	357.2	4.20826	-.207885
39	-23.1411	-63.5796	79.3333	3.49402	356.9	3.489	-.187137
40	-23.1411	-63.5796	84.	2.73378	356.7	2.72924	-.157621
41	-23.1411	-63.5796	88.6667	1.92839	356.5	1.92472	-.118906
42	-23.1411	-63.5796	93.3333	1.0631	356.2	1.06081	-.0697845
END	-23.1411	-63.5796	98.	0	0	0	0
GND	-46.2822	-127.159	0	4.49865	103.1	-1.02103	4.38125
44	-46.2822	-127.159	4.66667	4.54838	102.6	-.994235	4.43839
45	-46.2822	-127.159	9.33333	4.55149	102.3	-.970335	4.44685
46	-46.2822	-127.159	14.	4.5237	102.	-.943373	4.42424
47	-46.2822	-127.159	18.6667	4.46713	101.8	-.912727	4.37289
48	-46.2822	-127.159	23.3333	4.383	101.6	-.878256	4.29411
49	-46.2822	-127.159	28.	4.27221	101.3	-.840001	4.18882
50	-46.2822	-127.159	32.6667	4.13563	101.1	-.798112	4.05789
51	-46.2822	-127.159	37.3333	3.97418	100.9	-.752815	3.90223
52	-46.2822	-127.159	42.	3.78885	100.7	-.704394	3.72279
53	-46.2822	-127.159	46.6667	3.58069	100.5	-.653162	3.52061
54	-46.2822	-127.159	51.3333	3.35084	100.3	-.599482	3.29678
55	-46.2822	-127.159	56.	3.10053	100.1	-.543742	3.05248
56	-46.2822	-127.159	60.6667	2.831	99.9	-.48635	2.78891
57	-46.2822	-127.159	65.3333	2.54347	99.7	-.427726	2.50725
58	-46.2822	-127.159	70.	2.23915	99.5	-.368288	2.20866
59	-46.2822	-127.159	74.6667	1.91906	99.2	-.308431	1.89411
60	-46.2822	-127.159	79.3333	1.58387	99.	-.248495	1.56426
61	-46.2822	-127.159	84.	1.23351	98.8	-.188709	1.21899
62	-46.2822	-127.159	88.6667	.866145	98.6	-.129052	.856477
63	-46.2822	-127.159	93.3333	.475326	98.3	-.0688602	.470311
END	-46.2822	-127.159	98.	0	0	0	0

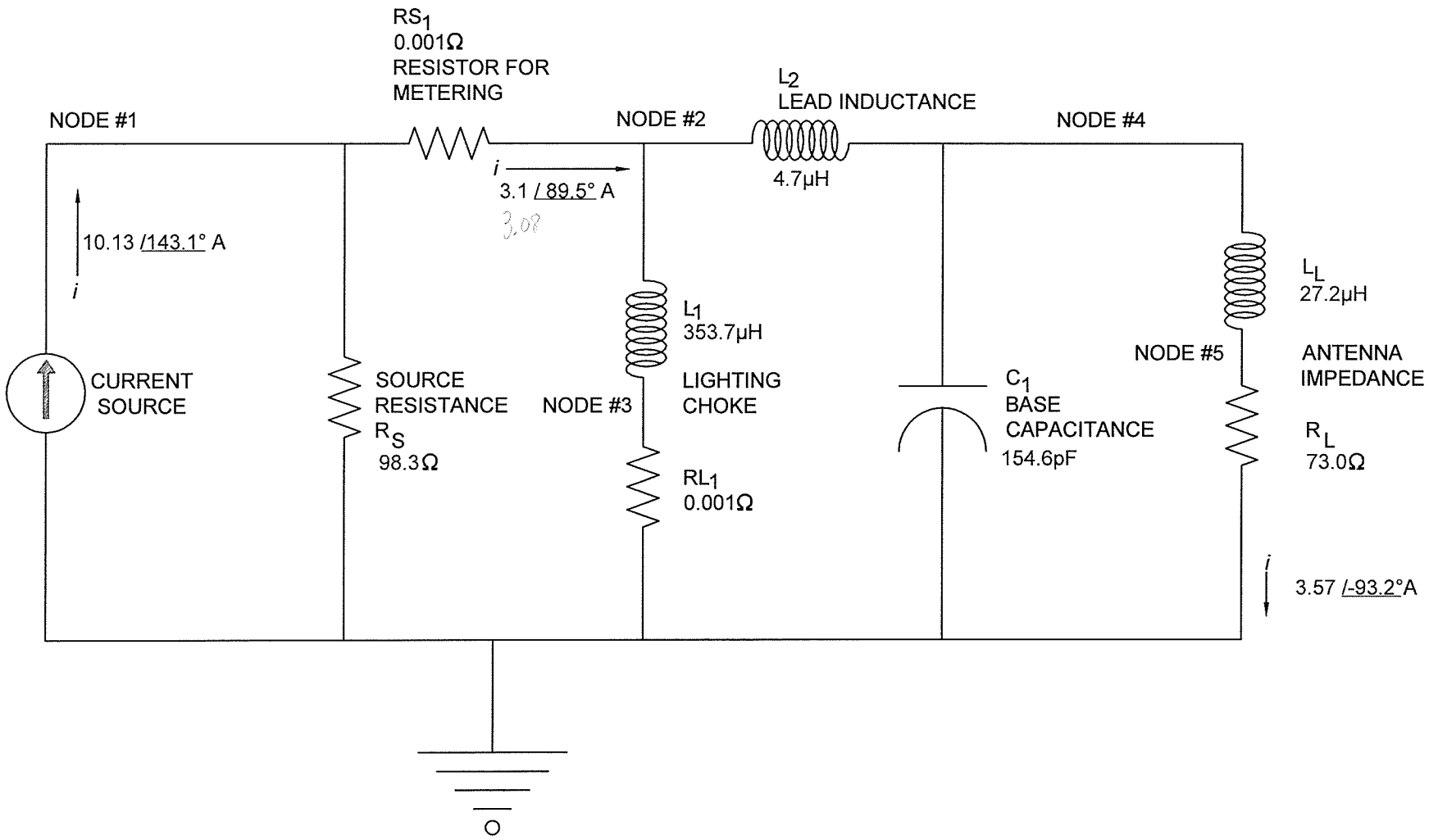
Tower 1

Input

```
## KPUG TOWER 1 BASE MODEL
.OPT LIST NOPAGE NODE NOMOD
.AC LIN 1 1170kHz 1170kHz

IIN      1        0        AC 10.132 143.13
rs       1        0        98.3
rs1      1        2        .001

L1       2        3        353.7uH
RL1      3        0        .001
L2       2        4        4.7uH
C1       4        0        154.6pF

LL       4        5        27.2uH
RL       5        0        73.0ohms

.PRINT AC VM(2,0) VP(2,0) VM(4,0) VP(4,0)
.PRINT AC IM(L1) IP(L1) IM(L2) IP(L2)
.PRINT AC IM(RS1) IP(RS1) IM(RL) IP(RL)
##.PROBE
.END
```

Output

FREQ	IM(RS1)	IP(RS1)	IM(RL)	IP(RL)
1.170E+06	3.077E+00	-8.947E+01	3.570E+00	-9.320E+01



Hatfield & Dawson Consulting Engineers	KPUG(AM) TOWER #1 PSPICE MODEL KPUG(AM) 1170 kHz BELLINGHAM, WA 07/2010	REVISIONS:

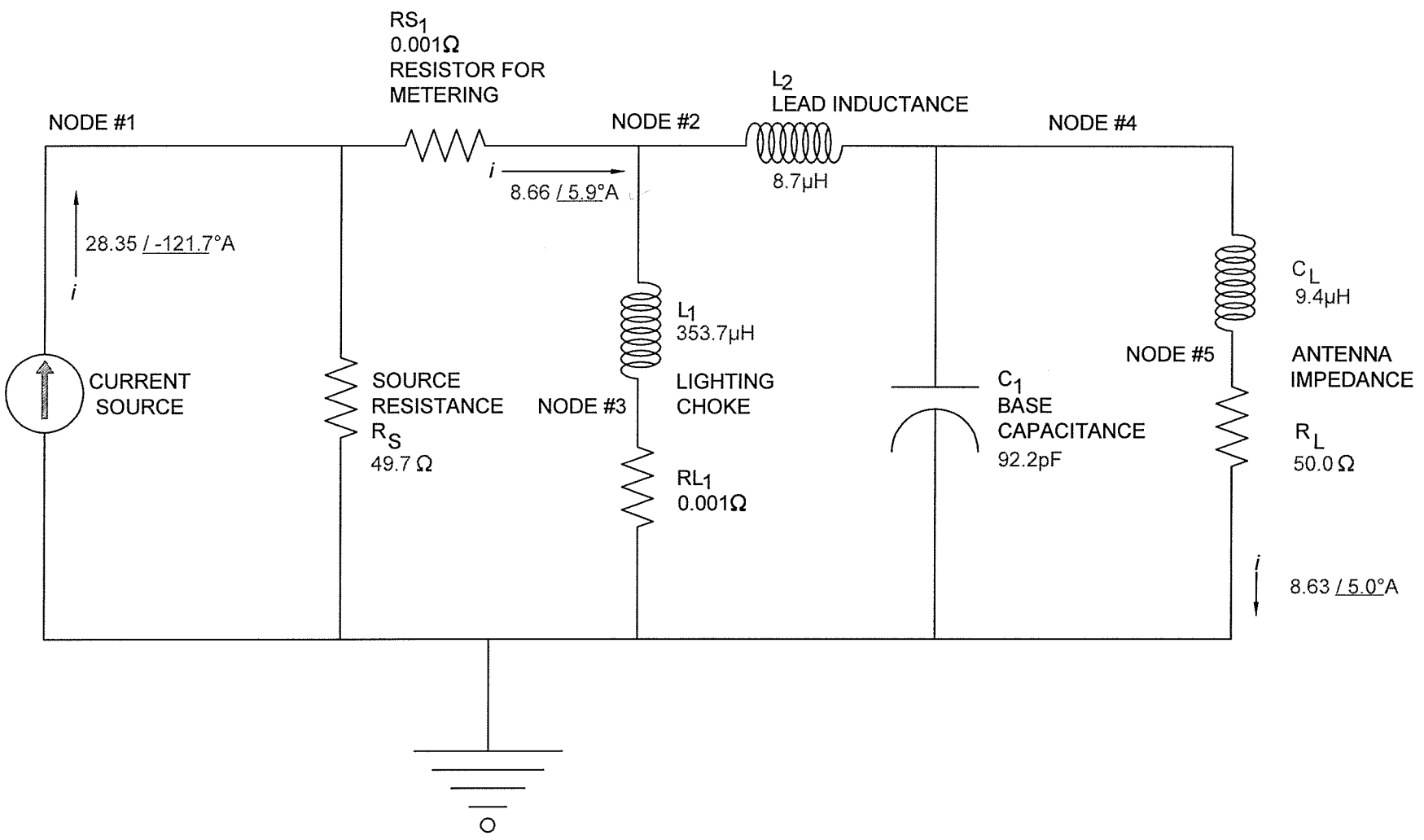
Tower 2

Input

```
## KPUG TOWER 2 BASE MODEL
.OPT LIST NOPAGE NODE NOMOD
.AC LIN 1 1170kHz 1170kHz

IIN     1       0       AC 28.35 -121.7
rs      1       0       49.7
rs1     1       2       .001

L1      2       3       353.7uH
RL1     3       0       .001
L2      2       4       8.7uH
C1      4       0       92.2pF

LL      4       5       9.4uH
RL      5       0       50ohms

.PRINT AC VM(2,0) VP(2,0) VM(4,0) VP(4,0)
.PRINT AC IM(L1) IP(L1) IM(L2) IP(L2)
.PRINT AC IM(RS1) IP(RS1) IM(RL) IP(RL)
##.PROBE
.END
```

Output

FREQ	IM(RS1)	IP(RS1)	IM(RL)	IP(RL)
1.170E+06	8.658E+00	5.933E+00	8.629E+00	5.048E+00



Hatfield & Dawson Consulting Engineers	KPUG(AM) TOWER #2 PSPICE MODEL KPUG(AM) 1170 kHz BELLINGHAM, WA 07/2010	REVISIONS:

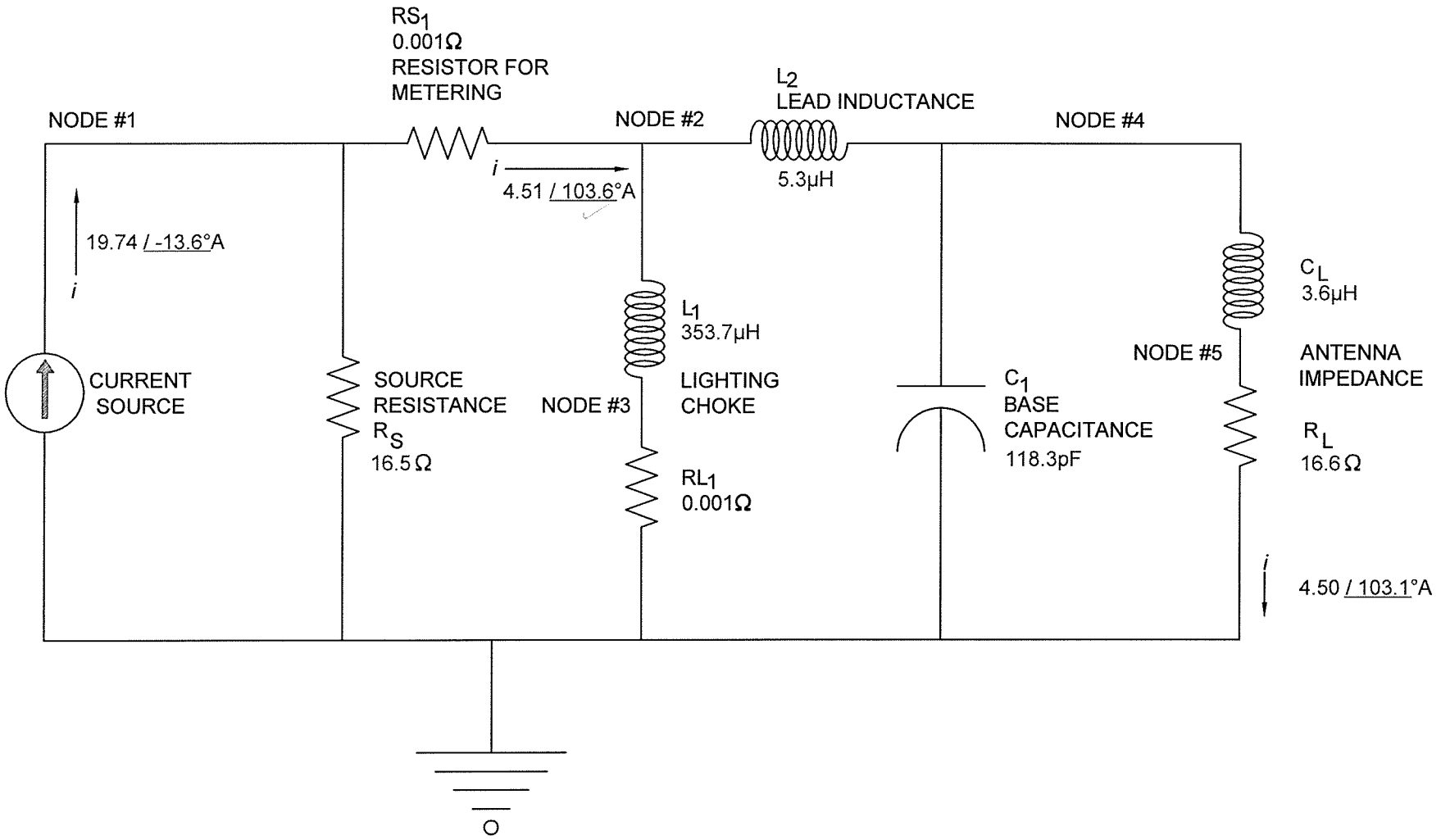
Tower 3

Input

```
## KPUG TOWER 3 BASE MODEL
.OPT LIST NOPAGE NODE NOMOD
.AC LIN 1 1170kHz 1170kHz

IIN     1       0       AC 19.74 -13.6
rs      1       0       16.5
rs1     1       2       .001

L1      2       3       353.7uH
RL1     3       0       .001
L2      2       4       5.3uH
C1      4       0       118.3pF

LL      4       5       3.6uH
RL      5       0       16.6ohms

.PRINT AC VM(2,0) VP(2,0) VM(4,0) VP(4,0)
.PRINT AC IM(L1) IP(L1) IM(L2) IP(L2)
.PRINT AC IM(RS1) IP(RS1) IM(RL) IP(RL)
##.PROBE
.END
```

Output

FREQ	IM(RS1)	IP(RS1)	IM(RL)	IP(RL)
1.170E+06	4.507E+00	1.036E+02	4.498E+00	1.031E+02



Hatfield & Dawson Consulting Engineers	KPUG(AM) TOWER #3 PSPICE MODEL KPUG(AM) 1170 kHz BELLINGHAM, WA 07/2010	REVISIONS:

Calculated Antenna Monitor Parameters

	Modeled Current Pulse	Sample Current Calculated at TCT (Amps)		Antenna Monitor Parameters	
		Magnitude	Phase (°)	Ratio	Phase (°)
Tower 1 West	Node 1	3.077	-89.5°	0.355	-95.4°
Tower 2 Center	Node 22	8.658	5.9°	1.000	0.0°
Tower 3 East	Node 43	4.507	103.6°	0.521	97.7°

ITEM 3- Moment Method Model for Tower Driven Individually

Expert MININEC Broadcast Professional Version 12.5 was used to model the KPUG array. The antenna model was adjusted to match the measured matrix impedances. The wire coordinates used are in electrical degrees and wire radius is in meters The physical height of the triangular cross section towers is 80.4°, the face width is 24 inches. The following adjusted parameters were used:

- antenna electrical height on towers was adjusted to 106.4% of the physical height (98°)
- wire radius of 95.2% (0.20 meters) of the equivalent radius of the tower was used
- 21 segments per antenna element (4.7° per segment) were used

North Tower #1 Model

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:39:38

KPUG Night

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2	21
		0	0	98.		
2	none	67.66	110.	0	.2	21
		67.66	110.	98.		
3	none	135.32	110.	0	.2	21
		135.32	110.	98.		

Number of wires = 3
current nodes = 63

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	4.66667	1	4.66667
radius	1	.2	1	.2

ELECTRICAL DESCRIPTION
Frequencies (KHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1,170.	0	1	.012963	.012963

Sources

source	node	sector	magnitude	phase	type
1	1	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	22	1.E+06	0	0	0	0
2	43	1.E+06	0	0	0	0

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:39:38

IMPEDANCE
normalization = 50.

freq (KHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1,170.	54.65	66.567	86.127	50.6	3.3292	-5.384	-1.4842

Center Tower #2 Model

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:35:28

KPUG Night

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2	21
		0	0	98.		
2	none	67.66	110.	0	.2	21
		67.66	110.	98.		
3	none	135.32	110.	0	.2	21
		135.32	110.	98.		

Number of wires = 3
current nodes = 63

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	4.66667	1	4.66667
radius	1	.2	1	.2

ELECTRICAL DESCRIPTION
Frequencies (KHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1,170.	0	1	.012963	.012963

Sources

source	node	sector	magnitude	phase	type
1	22	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	1.E+06	0	0	0	0
2	43	1.E+06	0	0	0	0

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:36:15

IMPEDANCE
normalization = 50.

freq (KHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 22, sector 1							
1,170.	52.989	62.784	82.156	49.8	3.1763	-5.6614	-1.376

South Tower #3 Model

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:41:01

KPUG Night

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2	21
		0	0	98.		
2	none	67.66	110.	0	.2	21
		67.66	110.	98.		
3	none	135.32	110.	0	.2	21
		135.32	110.	98.		

Number of wires = 3
current nodes = 63

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	4.66667	1	4.66667
radius	1	.2	1	.2

ELECTRICAL DESCRIPTION
Frequencies (KHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1,170.	0	1	.012963	.012963

Sources

source	node	sector	magnitude	phase	type
1	43	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	1.E+06	0	0	0	0
2	22	1.E+06	0	0	0	0

C:\AM\KPUG\Model\KPUG-ND 03-18-2010 14:41:01

IMPEDANCE
normalization = 50.

freq (KHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 43, sector 1							
1,170.	54.65	66.566	86.126	50.6	3.3292	-5.3841	-1.4841

ITEM 4 - Moment Method Model for Directional Array

Input File:
C:\AM\KPUG\Model\KPUG 03-18-2010 14:02:06

KPUG Night
GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.2	21
		0	0	98.		
2	none	67.66	110.	0	.2	21
		67.66	110.	98.		
3	none	135.32	110.	0	.2	21
		135.32	110.	98.		

Number of wires = 3
current nodes = 63

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	1	4.66667	1	4.66667
radius	1	.2	1	.2

ELECTRICAL DESCRIPTION
Frequencies (KHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	1,170.	0	1	.012963	.012963

Sources

source	node	sector	magnitude	phase	type
1	1	1	1,076.23	336.7	voltage
2	22	1	1,041.84	59.1	voltage
3	43	1	198.538	160.9	voltage

C:\AM\KPUG\Model\KPUG 03-18-2010 14:33:13

IMPEDANCE
normalization = 50.

freq (KHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
1,170.	73.026	199.96	212.87	69.9	13.018	-1.337	-5.7678
source = 2; node 22, sector 1							
1,170.	50.039	69.117	85.329	54.1	3.6342	-4.9065	-1.6948
source = 3; node 43, sector 1							
1,170.	16.645	26.397	31.207	57.8	3.919	-4.5329	-1.8852

C:\AM\KPUG\Model\KPUG 03-18-2010 14:34:35

CURRENT MOMENTS(amp-degrees) rms

Frequency = 1170 KHz
Input power = 5,000. watts

			vertical current moment	
wire	magnitude	phase (deg)	magnitude	phase (deg)
1	322.446	261.	322.446	261.
2	632.247	0.0	632.247	0.0
3	303.479	101.	303.479	101.

Medium wave array vertical current moment (amps-degrees) rms
(Calculation assumes tower wires are grouped together.
The first wire of each group must contain the source.)

tower	magnitude	phase (deg)
1	322.446	261.
2	632.247	0.0
3	303.479	101.

ITEM 5 - Sampling System Measurements

Measurements were made using a HP 8751A network analyzer, an ENI 403LA amplifier and custom manufactured directional couplers in a calibrated measurement system. The sample line was found to be series resonant (an odd multiple of 90° which is an impedance zero - very low resistance and zero reactance) around 873 kHz which is 90° for this length of transmission line. The characteristic impedance was calculated using the following formula, where $R_1 \pm jX_1$ and $R_2 \pm X_2$ are the measured impedances at the -45° and +45° offset frequencies:

$$Z_0 = \sqrt{\sqrt{R_1^2 + X_1^2} \bullet \sqrt{R_2^2 + X_2^2}}$$

The measured open circuit sample line impedances and characteristic impedance calculations are shown below:

Lines from ATUs to Transmitter Building

	Resonance Frequency (kHz)	-45° Offset Frequency (kHz)	-45° Offset Impedance ($R_1 \pm jX_1$) (Ohms)	+45° Offset Frequency (kHz)	+45° Offset Impedance ($R_2 \pm jX_2$) (Ohms)	Characteristic Impedance ($Z_ø$)
Sample Line 1 (Center Tower)	872.80	727.333	4.4 - j 50.6	1018.267	3.5 + j 50.1	50.5 ohms
Sample Line 2 (West Tower)	872.10	726.750	4.5 - j 50.6	1017.450	3.5 + j50.5	50.4 ohms
Sample Line 3 (East Tower)	873.40	727.833	4.5 - j 50.7	11018.967	3.5 + j 50.7	50.5 ohms

The sample line lengths calculated from the measurements above are:

Length in Electrical Degrees at 1170 kHz	Length from ATU to Transmitter Building	Measured Impedance (Z_S) With Sample Transformer Attached
Sample Line 1	361.9°	50.2 - j 0.2 ohms
Sample Line 2	362.2°	50.1 - j 0.2 ohms
Sample Line 3	361.7°	50.2 - j 0.3 ohms

ITEM 6 - Reference Field Strength Measurements

110° 1.25 km 70 mV/m
48° 46' 19.0" 122° 25' 30.2"
Stop Sign at Barkley Blvd & Tanglewood

110° 3.56 km 20 mV/m
48° 45' 54.2" 122° 23' 42.8"
End of pavement on E.17th Crest (south of Academy Rd) just past 3397 E. 17th Crest.

110° 6.72 km 3.0 mV/m
48° 45' 19.6" 122° 21' 16.9"
Center of parking lot of "The Fork" restaurant at North Shore Rd & Y Rd.

290° 2.13 km 290 mV/m
48° 46' 56.4" 122° 28' 5.9"
Mailbox for 1011 E. McLeod Rd. (West of James St. Rd.)

290° 3.95 km 110 mV/m
48° 47' 15.7" 122° 20' 30.0"
Stop Sign at SW corner of Bellis Fair Pkwy & Cordata Pkwy (north of Kohl's department store)

290° 5.17 km 100 mV/m
Fireplug in front of 102 Orchid Place (East of Aldrich Rd.)

KPUG reference coordinates: 48° 46' 32.6" 122° 26' 27.7"

All coordinates on this page are NAD83

All field strength readings were taken with a Potomac Instruments FIM-41, Serial No. 647 last calibrated in October 2008.

All coordinates were taken with a WAAS enabled GPS receiver with a stated accuracy of 2 meters.

ITEM 7 - Direct Measurement of Power

Common point impedance measurement were made using a HP 8751A network analyzer, an ENI 403LA amplifier and custom manufactured directional couplers in a calibrated measurement system. The measurements were made at the phasor cabinet input adjacent to the common point current meter that is used to determine operation power. The impedance measured at this point was adjusted to a value of 50 ± j0 for the directional antenna system.

The measured daytime non-directional impedance for tower #2 is 45.3 +j121.1 ohms.

ITEM 8 - Antenna Monitor and Sampling System

The sample system installed consists of Delta Electronics TCT-2 toroidal current transformers (TCT) installed inside the tuning houses at the base of each tower. All three TCTs were compared with each other on the bench using the Network Analyzer and found to be in good working order. The TCTs are connected to a Gorman-Redlich CMR digital antenna monitor by equal lengths of1/2 inch Andrew LDF4-50A coaxial cable. This cable has a foam dielectric, and solid copper inner and outer conductors. These lines were verified to have equal electrical lengths. All excess cable is neatly coiled in the basement of the transmitter building. The antenna monitor was tested with a signal generator, a Tee connector and equal lengths of cable. The two signals were fed into the reference and sample inputs and the monitor was found to be in good working order. This antenna monitor has been serviced and calibrated at the factory within the last two years. There is no change to the ground system, the description contained in the current station license remains accurate.